Model: Varian 710-ES
Introduction

ICP-OES (figure 1) is an analytical method used to determine elemental composition in the sub ppm range. In the ICP-OES instrument, an ICP source dissociates the sample into its constituent atoms or ions and excites them so that they emit light of a characteristic wavelength. Many elements can be screened per single sample run of less than one minute and the samples can be analyzed in a variety of aqueous or organic matrices. The detection limit of the instrument is ≤1ppm. Solid samples must be dissolved or digested to run on ICP. 4-5 mL of the sample is required for a good run, smaller samples can be diluted to this volume if necessary.

Inductively Coupled Plasma techniques operate by decomposing a liquid sample by intense heat into a cloud of hot gases with an inductive coupled plasma (a state of matter containing electrons and ionised atoms of Argon). The plasma reaches temperatures of around 10,000°C. The high temperature causes excitation and ionisation of the sample atoms. Once the atoms or ions are in their excited energy states, they can decay to lower energy states whilst emitting light of specific wavelengths depending of the elements in the solution. In OES, the intensity of the light emitted at specific wavelengths is measured and used to determine the concentrations of the elements of interest

A minimum of three standard solutions is needed for calibration, for all elements of interest. These standards should have a concentration near the expected concentration for the sample. Commercial standards are available for many elements.

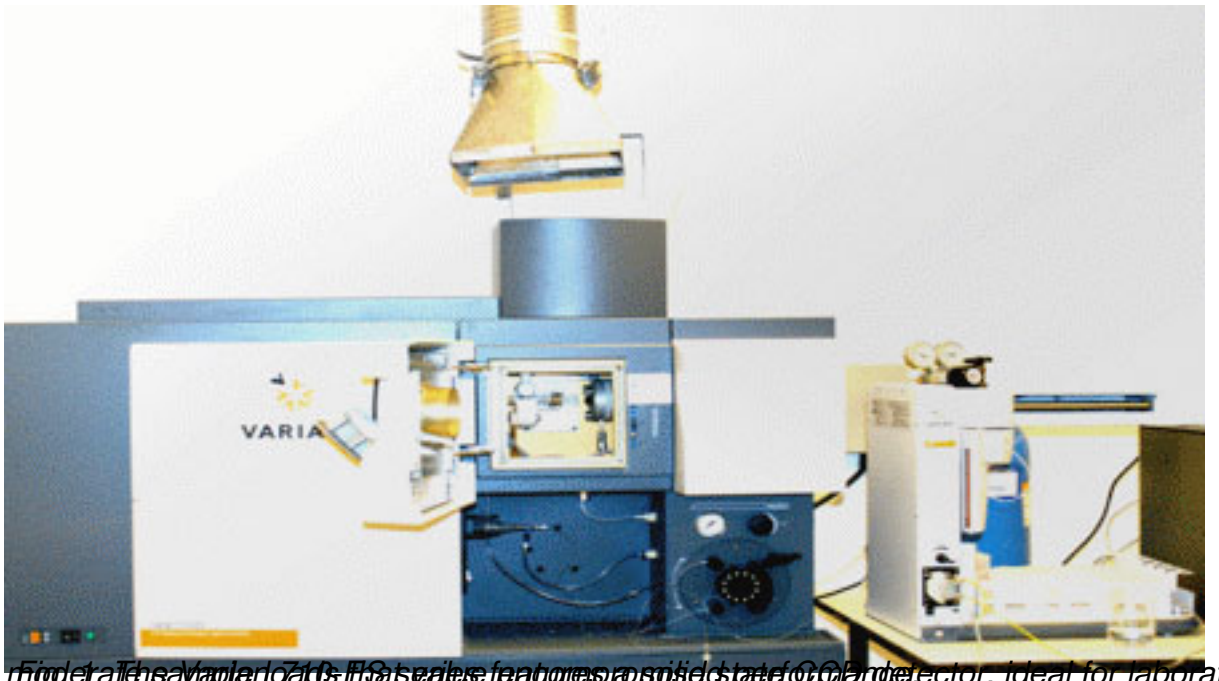

Figure 1. The Varian 710-ES series features a solid state CCD detector, ideal for laboratories with high throughput and routine analysis requirements.

Calibration

A calibration is necessary for quantitative analysis (figure 2). By comparing the intensity of light emitted by solutions of known metal concentrations with unknown sample solutions, metal concentration can be determined.

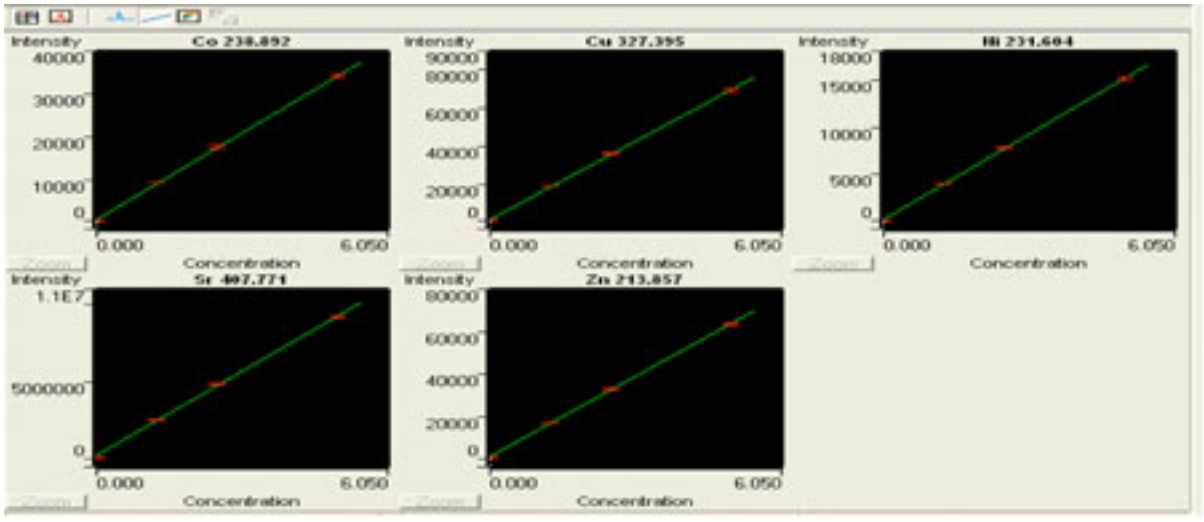

Figure 2. Calibration curve for Co, Cu, Ni, Sr and Zn: intensity measured from standards of 0. 1. 2. 4 and 10 mg l^{-1}

Advantages and limitations of ICP-OES

ICP-OES is a moderately sensitive techniques that can analyse a wide range of elements simultaneously. Under optimum conditions it can analyse over 100 samples per day. It is important, however, to be aware of the limitations of the method. These include:

- Spectral interference between different elements. The wavelength of one element's light emission can sometimes be close enough to that of another element to cause problems.
- Matrix effects caused by high concentrations of an element in the sample, (most commonly the easily ionisable Na, K, Mg or Ca) can change the way the sample is introduced to the flame or the thermal characteristics of the plasma and lead to over or underestimation of sample concentration.
- Optimum conditions for analysis occur for different elements under different conditions, therefore sensitivity can be compromised when running for multi-element analysis.

Specifications of ICP-OES Varian 710-ES

Note :For optimum analytical performance it is recommended that the ambient temperature of the laboratory be between 20–25 °C and be held constant to within ±2 °C throughout the entire working day.

1. Gas Supplies

The main gas supply requirement is argon for supply to the plasma, nebulizer, optics interface for Varian 710/-ES instrument.

Instrument gas specifications

Purity	
99.996%	
Oxygen	
<5 ppm	
Nitrogen (argon only)	
<20 ppm	
Water vapor	
<4 ppm	
Permissible pressure range	
400–600 kPa (57–88 psi)	

Recommended pressure

550 kPa (80 psi) regulated

Required flow rates

0.7–32 L/min

2.Water Supply

Cooling requirements

Cooling capacity

1 kW

Flow rate

1.1 L/min (0.3 gpm) minimum

Recommended inlet temperature

Maxim temperature is: 45 °C (113 °F))

Minimum inlet pressure

55 kPa (8.0 psi)

Maximum inlet pressure

310 kPa (45 p

Applications

ICP-OES is solution-based analytical technique, although solid sampling has been must dissolve first and pursued in this type of equipment with varying degrees of success. Due to commonality of sample type and sample preparation, it is understandable that this technique serve the same analytical needs.

The following sample types can be analysed without the need for any major pre-treatments

- Metals and alloys
- Ores, rocks and minerals
- Petroleum products
- Water and effluents
- Agricultural products
- Foods and beverages
- Horticultural research
- Environmental
- Clinical and pharmaceutical
- Cements, glasses and ceramics